Mount Rainier National Park

Sister Mountain Project

| Playdough Topo | |
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| **Overview** | Students make a clay model volcano, and then create a topographic map of it. This lesson is adapted from the USGS Living with a Volcano in Your Backyard curriculum. |
| **Grade Level** | 5-12 |
| **Objectives** | Students will be able to:<br>Recognize mountains and river valleys on a topographic map<br>Visualize how a 2–dimensional topographic map represents 3–dimensional landscape<br>Understand contour lines and contour interval<br>Increase their spatial visualization skills |
| **Setting** | Classroom |
| **Timeframe** | 50-90 minutes, depending on the complexity of the model volcanoes |
| **Materials** | 3-D model extension supplies (16 disposable tray lids, sheets of craft foam or sheets of foam board and student copies of Mt Fuji and Mt Rainier topographic maps)<br>Copies of "Play–Dough Topo" student page<br>Copy of "Play–Dough Topo" teacher discussion questions. Soft modeling clay (pottery clay also works well but can be messy) You can substitute with homemade Play Dough made from flour and salt. See recipe below.<br>Fishing line or clay cutting wire<br>1/4" dowel or a pencil |
| **Vocabulary** | Elevation, topography, topographic map, contour line, contour interval, map scale |
| **Skills** | Model, interpret, compare, demonstrate, visualize |
| **Benchmarks** | 1 – Uses maps, charts, and other geographic tools to understand the spatial arrangement of people, places, resources, and environments on Earth's surface<br>1.1 – Use and construct maps, charts, and other resources to gather and interpret geographic information<br>1.1.2b – Uses data and a variety of symbols and colors to create thematic maps, mental maps, and graphs depicting geographic information<br>1.2 – Recognize spatial patterns on Earth's surface and understand the processes that create these patterns<br>1.2.2b – Analyze how human spatial patterns emerge from natural processes and human activities<br>2 – Understands the complex physical and human characteristics of places and regions |

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| | 2.1 – Describe the natural characteristics of places and regions and explain the causes of their characteristics<br>2.1.2 – Use observation, maps, and other tools to identify, compare, and contrast the physical characteristics of places and regions |
| **Background** | Mapmakers have devised an ingenious way to show three–dimensional topography on a two dimensional flat surface with the use of a topographic map. On these maps contour lines illustrate the variations in elevation of surface terrain. A contour line is defined as a line of equal elevation. If you were to walk on a contour line painted on the ground around the side of a hill you would neither go up nor down, but remain level. The elevation difference between adjacent contour lines, called the contour interval, is selected to best show the pattern of the landscape. Relatively flat landscapes often are illustrated with a small contour interval of 10 feet or less. Maps in mountainous areas, however, often have a larger contour interval of 40 feet or more. The contour interval is usually printed under the scale at the bottom of topographic maps. Topographic maps can present a major challenge in the classroom, but practice in interpreting them is an excellent way to develop spatial relations skills and is a useful tool in its own right. This activity is designed to develop an understanding of what the contour lines on the map represent, as well as introduce the term "contour interval." |
| **Procedure** | 1. Shape a Volcano:<br><br>Distribute 450 grams (1 pound) lumps of clay to each student or group. Each student (or pair or small group) places the clay on a piece of scrap paper. They will shape the mound into a cone–pointy side up–roughly the shape of a stratovolcano like Mount Rainier. For more advanced classes, encourage students to make realistically shaped volcanoes, approximating the shape of Mount Rainier. Remind students that each side of the volcano may have a different slope, or steepness. Consider making U–shaped glacial valleys running down the sides of the model using the back of a spoon, and then putting in some smaller V–shaped valleys, representing those carved by rivers and streams, using a pointed wooden tool or a butter knife.<br><br>2a. Make a Vertical Hole for Alignment of Parts Later in the Activity:<br><br>Next, for all students, use the 1/4–inch wooden dowel (or a pencil) to make a vertical hole from the summit of the volcano, all the way down to the work surface. Remove the pencil and mark this spot on your paper. This mark will allow students to align the pieces of their model on the paper as they make a topographic map, so they should be able to see through it.<br><br>2b. Choose North<br><br>Choose a direction for north, such as the front of the classroom, and then make a straight groove down the outside of the model facing north. You will need to know where north is on your clay pieces, so, make the groove obvious.<br><br>3. Measure and Record Elevation |

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| | Measure the elevation of the volcano and record it at question #1 on the student page. To make this measurement, stretch the wire across the top of the volcano to a vertical ruler<br>(See graphic). Each student or group should divide their answer by four or five to determine their contour interval, that is, the distance between each contour line to be drawn in Step 4. Rounding is permitted.<br><br>Write answer on student page at question #2.<br><br>4. Mark Dots to Show Elevation on the Model<br><br>Then, holding a pencil horizontal, ask students (or help them) to punch holes at each calculated contour interval, completely around their model. For younger children or with soft clay, use increments of 1 inch. For more advanced classes and with Play Dough, you may be able to make thinner slices, and so should use increments of 1 centimeter (~ .39 inch).<br><br>5. Slice the Model to Create Contour Lines<br><br>Next, using the wire tool or a length of fishing line wrapped securely around your hands, cut the model parallel to the work surface horizontally at the elevations marked by the dots. Tell students to try to keep their hands steady (advice for you if you are doing the slicing for younger classes) and to attempt to keep all slices parallel and of even thickness. Start with horizontal slices near the top. These slices, cutting through the model at one elevation, will make a slice that outlines the volcano at that elevation. Since the cut is all at the same elevation, the outline is a contour line. The distance from one cut to the next is the contour interval. Discuss these concepts with your class as the horizontal slicing continues.<br><br>6. Trace the Outline of Each Slice on Paper to Make a Contour Map of the Play-Dough Volcano Model<br>Distribute a piece of blank paper to each group of students. This will be made into a paper map of each volcano. Starting with the bottom-most, largest slice, center it on the paper, with the "North" groove facing the top of the page, and mark the position of the groove with a tic–mark. Use a pencil to make a distinct dot on the paper in the center of the dowel–hole. This dot will be used for centering all of the other pieces. Finally, carefully trace the outline of the slice, paying attention to indentations and the shapes made by any valleys you may have carved. Remove the slab and center the next piece of your model over the "dowel–dot," lining up the "North–groove" with the direction of the tic–mark, towards the top of the page. Carefully trace the shape. Repeat until all of the slices have been centered and traced. You have just created a topographic map of your volcano!<br><br>7. Reassemble the Volcano for Comparison with the Topographic Map |

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| | Reassemble your volcano and compare the three–dimensional model to your topographic map. Without smoothing the lines made by the cuts (your contour intervals), look down on both from above–they should match. Consider using the questions below to guide older students' inquiry. On their map, students should name their volcano, then list the contour interval, label the elevation of the summit, draw a north arrow, and state the name of the mapmaker. Consider drawing some hypothetical rivers as discussed in question #4. Color and border the map.<br><br>8. Hand out Play-Dough Topo student page and have students make their map on the back of the question sheet. They should label the summit and river valleys on their map. (see assessment for revisions to student page) Then have students answer the questions on the student page.<br><br>9. Hand out topographic maps of Japan and Washington (or any other locality). Have students identify peaks and river valleys by either labeling with post-its, recording latitude and longitude lines or if maps are laminated they can circle and label structures by writing on the map with overhead markers. You may want students to also write down a reason for each decision.<br><br>10. Now that students are more familiar with topographic contours, hand out the quadrangle maps of Mt Rainier and Mt Fuji. Ask students to compare and contrast the topography for both mountains. How are they similar? How are they different? Size? Max elevation? Shape? Steepness? # of river valleys? Shape of river valleys?<br><br>11. Have students check their interpretation of the quadrangle maps by completing the extension activity and comparing the 3-dimentional model to their written observations. Do they match? Students should write a reflection describing the accuracy of their observations and explaining how their observations may be improved. |
| **Adaptations** | Introduce students to more detailed topography by completing the "Topographic Maps and Mt Rainier activity" (see resources) before moving on to reading topographic maps steps 7-9.<br><br>Students could use both the 3-D models and the topographic maps concurrently to compare and contrast Mt Rainier and Mt Fuji<br><br>Students can view internet 3-D images online. Some require the use of 3-D goggles Stereoscopic images are available online too. Google Earth is also an option.<br><br>More tactile students could make the foam board version instead<br><br>Advanced students could add lava flows, craters etc to their play-dough volcanoes and then label their maps accordingly<br><br>Make a paper Mache or clay model of a cone–shaped Cascade volcano. To illustrate |

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| | how contour lines represent equal elevation, paint contour lines on your volcano. |
| **Extensions** | Scavenger hunt<br>Have students identify 10 objects etc on a topographic map and write clues for them<br>Have students exchange clues and identify the objects<br><br>Key<br>Have students make a "key" for identifying volcanic structures such as cone, crater, valley, ridge, plain on a topographic map by drawing an example of what the contours should look like for each structure.<br><br>3-D Map<br>Make a See-Through 3-D Salad-Tray Model of a Topographic Map.<br>From a delicatessen, bakery, or grocery store, obtain approximately 8 clear plastic disposable tray lids that can be nested, for each student group. Obtain a topographic map of a volcano. Use a photocopier to adjust the size of the volcano's cone so that it is almost as large as the flat bottom of the tray lids. Use a marker to outline principal contours on the reduced-size map (1,000 foot contours on Mount Rainier). Use scissors to trim the map so that it fits snugly inside the first tray lid. Temporarily tape the map in place. Use a permanent marker to trace one contour line onto each tray lid. Add contour elevations and a North arrow to each tray lid. Admire your 3–D representation of a topographic map!<br><br>Follow up with "Glaciers—Nature's Ice Sculptures" |
| **Assessment** | Use questions on the "Play-Dough Tope" student page to assess students' ability to apply the concept of contours to a physical model. Look for students' grasp of contour lines, and of how the lines represent real landform features. Note how students' understanding of contour lines has progressed throughout the activity. For example, at the beginning of the activity, students may have a rudimentary understanding of how contours represent the landscape. Later, students can describe the landscape based on their reading of the contours, can produce their simple contour map based on the model, and can answer questions about it successfully.<br>Compare and contrast with reflection from step 9<br><br>• How do you identify the peak of your volcano on your map?<br>• What would happen to your map if your contour interval were doubled? What about cut in half?<br>• If you needed to identify smaller details what change would you make to your contour interval? |
| **References** | Sato, T. "Anaglyph images of Mt Rainier and Mt Fuji" Anaglyph images of Topography for Geographical Education. Division of Liberal Arts, Nuazu National College of Technology. (e-mail tasoto@numazu-ct.ac.jp) |
| **Resources** | Driedger, C., Doherty, A., & Dixon, C. (2005) "Topographic Maps and Mt Rainier." Living with a volcano in you back yard-an educator's guide with emphasis on Mt Rainier. General Information Publication 19. Available on-line at |

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| | http://vulcan.wr.usgs.gov/Outreach/Publications/GIP19/chapter_three_topographic_maps.pdf<br><br>Rocky Mountain Mapping Center. USGS Topographic Maps Illustrating Physiographic Features. United States Geological Survey. Available on-line at http://rockyweb.cr.usgs.gov/outreach/featureindex.html<br><br>Japan Aerospace Exploration Agency. Earth Observation Research Center: Seen From Space.<br>http://vulcan.wr.usgs.gov/Outreach/Publications/GIP19/chapter_three_topographic_maps.pdfhttp://www.eorc.jaxa.jp/en/imgdata/topics<br><br>Terrain Visualization and Flyby Animation Gallery<br>http://www.visualizationsoftware.com/3dem.html<br><br>Mt Rainier 1; 100,000 topographic maps can be downloaded from the USGS website<br>http://store.usgs.gov/b2c_usgs/usgs/maplocator/(layout=6_1_61_48&uiarea=2&ctype=catalogEntry&carea=%24ROOT)/.do |